

WHAT IS CLAIMED IS:

1 1. An image display apparatus, comprising:
2 a source unit to generate a spatially uniform light beam that
3 propagates along a first beam path in a first direction;
4 an imaging unit to collect and focus the light beam, wherein the
5 imaging unit includes;
6 a first refractive optical element disposed in the first beam
7 path,
8 a second refractive optical element disposed in the first
9 beam path,
10 a first reflecting mirror disposed in the first beam path,
11 and
12 a second reflecting mirror disposed in a second beam path
13 defined by the first reflecting mirror and the second reflecting mirror,
14 wherein the second beam path is oriented in a second direction
15 different from the first direction, and wherein the second reflecting
16 mirror has a concave reflecting surface;
17 a digital micromirror device ("DMD") to receive the light beam
18 reflected by the second reflecting mirror and disposed in a third beam path
19 defined by the second reflecting mirror and the DMD, wherein the third beam
20 path is oriented in a third direction different from the second direction; and
21 a projection lens to collect and project the light beam reflected
22 from the DMD and disposed in a fourth beam path defined by the DMD and
23 the projection lens, wherein the fourth beam path is oriented in a fourth
24 direction different from the third direction.

1 2. The image display apparatus of claim 1, wherein the second
2 beam path forms a first lateral angle of about 60 degrees to about 62 degrees
3 with respect to the X axis and a first tilt angle of about -114 degrees to about
4 -116 degrees with respect to the Y axis.

1 3. The image display apparatus of claim 1, wherein the third beam
2 path forms a second lateral angle of about -74 degrees to about -76 degrees
3 with respect to the X axis and a second tilt angle of about 64 degrees to
4 about 66 degrees with respect to the Y axis.

1 4. The image display apparatus of claim 1, wherein the fourth beam
2 path forms a third lateral angle of about 90 degrees with respect to the X axis
3 and a third tilt angle of about -79 degrees to about -81 degrees with respect
4 to the Y axis.

1 5. The image display apparatus of claim 1, wherein the source unit
2 comprises a light source defining a first end of the first beam path;
3 a lamp reflector to collect and reflect light generated by the light
4 source;
5 a color wheel to selectively transmit red, green, and blue
6 components of the light beam; and
7 a light integrator disposed in the first beam path.

1 6. The image display apparatus of claim 1, wherein the first
2 refractive optical element is a first lens having at least one aspheric surface
3 and having an effective focal length of about 16 mm, and wherein the second
4 refractive optical element is a second lens having at least one aspheric
5 surface and having an effective focal length of about 16.3 mm.

1 7. The image display apparatus of claim 1, wherein the effective
2 focal length of second mirror is about 30 mm to about 32 mm.

1 8. The image display apparatus of claim 1, further comprising:
2 a housing to house the source unit, the imaging unit, the DMD,
3 and the projection lens, wherein a length of the housing is about 160 mm to
4 about 180 mm, a width of the housing is about 140 mm to about 150 mm, and
5 a height of the housing is about 60 mm to about 70 mm.

1 9. A projection system, comprising:
2 a source unit to generate a spatially uniform light beam that
3 propagates along a first beam path in a first direction;
4 an imaging unit to collect and focus the light beam, wherein an
5 optical beam path in the imaging unit comprises the first beam path, a second
6 beam path, a third beam path, and a fourth beam path; and
7 a projection lens, wherein
8 the first beam path is defined by the source unit and a first
9 reflecting mirror, the second beam path is defined by the first reflecting mirror
10 and a second reflecting mirror, the third beam path is defined by the second
11 reflecting mirror and a digital micromirror device, the fourth beam path is
12 defined by the DMD and a projection lens to collect and project the light beam
13 reflected from the DMD, and said second reflecting mirror is a concave mirror.

1 10. The projection system of claim 9, wherein
2 the second beam path is oriented in a second direction different
3 from the first direction,
4 the third beam path is oriented in a third direction different from
5 the second direction, and
6 the fourth beam path is oriented in a fourth direction different
7 from the third direction.

1 11. The projection system of claim 10, wherein the second beam
2 path forms a first lateral angle of about 60 degrees to about 62 degrees with
3 respect to the X axis and a first tilt angle of about -114 degrees to about -
4 116 degrees with respect to the Y axis.

1 12. The projection system of claim 10, wherein the third beam path
2 forms a second lateral angle of about -74 degrees to about -76 degrees with
3 respect to the X axis and a second tilt angle of about 64 degrees to about 66
4 degrees with respect to the Y axis.

1 13. The projection system of claim 10, wherein the fourth beam path
2 forms a third lateral angle of about 90 degrees with respect to the X axis and
3 a third tilt angle of about -79 degrees to about -81 degrees with respect to
4 the Y axis.

1 14. The projection system of claim 9, wherein the optical beam path
2 in the imaging unit resides in a housing and occupies a volume of about 5.5
3 inches³.